PALEONTOLOGY.—*Pleistocene remains found near Lake Tacarigua, Venezuela.*[1] CHARLES T. BERRY. (Communicated by EDW. W. BERRY.)

In the past few years some very interesting archaeological work has been done around the eastern end of Lake Tacarigua, commonly noted on some recent maps as Lake Valencia or Lake Maracay, a part of which is in the State of Aragua, Venezuela. Lake Tacarigua is situated about 25 miles inland from the northern coast of Venezuela at an altitude of about 1400 feet. Dr. Rafael Requena, who conducted the archaeological work, has brought to light many finds which suggest a lake-dwelling type of people. With these human remains were found many shells both marine and terrestrial, all well preserved. These shells and several small samples of the material in which they were found, were collected from Bennet Mound near La Mata and were forwarded to me from Dr. Requena through Dr. J. A. Tong of Caracas, Venezuela. It is this material which forms the basis of the present paper.

I wish to express my sincere thanks to Dr. Henry A. Pilsbury of the Academy of Natural Sciences of Philadelphia for identifying the shells sent him. To K. E. Lohman of the United States Geological Survey I am indebted for the determination of the diatoms and sponge spicules found in the marl bed. Also I wish to thank Dr. C. H. Blake of the Massachusetts Institute of Technology for the identification of the ostracods found in the marl bed.

It is common knowledge that most prehistoric people had trade routes by means of which they traded implements and ornaments. The marine organisms found near Lake Tacarigua had been used for two purposes; food, and the shells for ornamentation. This fact means that the people of that time must have made the trip in a comparatively short time from the sea coast to their homes or else the food would have spoiled in the tropical climate.

The complete list of marine shells that I received, which were found in the upper bed are:

Codakia orbicularis
Fissurella rosea Fischer.
Fissurella nodosa Born.
Cittarium pica Linné.
Nerita versicolor Gmel.
Tectarius muricatus Linné.
Strombus gigas Linné.
Oliva recticularis Lam.

[1] Received Nov. 11, 1933.

The shells of *Strombus gigas* are broken in such a manner as would occur only if the animal had been used for food. Of the two different species of limpets (*Fissurella* spp.) those belonging to *Fissurella rosea* show undoubtedly that they were used as ornaments. The edges of the shells are smooth and show evidence of having been shaped. The slit in the apex of the shell was very useful for stringing on some variety of cord, thus making a necklace. Requena[2] pictures several such necklaces of limpets and other shells. *Oliva recticularis* has a straight hole running through the shell lengthwise from the apex to the lower end of the aperture. Again in both *Nerita versicolor* and *Tectarius muricatus* the shells have a small oblong hole in the first whorl, just opposite the aperture. In *T. muricatus* the holes are worn smooth along the edges and in *N. versicolor* the teeth on the outer lip of the aperture are nearly all worn away.

The fossils which I have received have come from two successive beds. The upper one—which is covered by about 8 feet of top soil consisting of sand and clay—is from 2 to 3 feet thick. The lower bed—which has been penetrated to a depth of 2 feet by the archaeological excavations—is of unknown thickness. This lower bed is a freshwater marl, consisting entirely of calcareous material. The areal extent of this bed, however, is as yet not known. Innumerable shells of *Planorbis pronus* are the dominant organisms found in the lower bed. Apparently at the time this bed was deposited the waters teemed with ostracods, for it now contains literally millions of them. However, there seem to be only a limited number of species represented. They belong to the following genera; *Cryptocandona, Dolerocypris, Spinocypris, Cyridopsis, Potamocypris, Darwinula,* and *Cytheridella.* Numerous fish scales, ribs, and vertebral ossicles were found which have been determined as belonging to *Geophagus brasiliensis.* This fish seems to have been the most common, if not the only one, which inhabited the lake at that time. It is a species that inhabits freshwater in tropical regions of both South America and Africa today. It is similar in size, color, and habits to our common sunfish of North America. Many scales, ribs, and vertebral ossicles were found in the upper bed also. Some small *Unio* shells were also found, but were too young to be definitely determined.

The following is the complete list of all the different organisms found in the lower or marl bed;

Fishes

Geophagus brasiliensis Quoy & Gaimard

[2] REQUENA, R. *Vestigios de la Atlantida.* Caracas. p. 47. 1932.

Mollusca
Planorbis pronus v. Mart.
Potamopyrgus parvulus Gldg.
Unio sp.
Snail teeth
Eucrustacea
Cryptocandona valencia n.sp. Blake
Dolerocypris berryi n.sp. Blake
Spinocypris macracanthos n.g. et n.sp. Blake
Cypridopsis fuhrmanni? Mehes
Potamocypris sp.
Darwinula sp.
Cytheridella tacarigua n.sp. Blake
Diatoms
Melosira cf. *M. italica* (Ehrenberg) Kützing
Melosira cf. *M. sulcata* (Ehrenberg) Kützing
Cyclotella meneghiniana var. *rectangulata* Grunow
Stephanopyxis corona (Ehrenberg) Grunow
Fragilaria brevistriata Grunow
Fragilaria construens (Ehrenberg) Grunow
Sceptroneis sp.
Synedra cf. *S. ulna* (Nitzsch) Ehrenberg
Navicula cf. *N. halophila* (Grunow) Cleve
Navicula cf. *N. occoneiformis* Gregory
Pinnularia cf. *P. dactylus* Ehrenberg
Anomoeoneis sphaerophora (Ehrenberg) Pfitzer
Gomphonema ventricosum Gregory
Cymbella ventricose Kützing
Epithemia sp.
Rhopolodia gibba (Kützing) Müller
Rhopolodia ventricosa (Kützing) Müller
Nitzschia cf. *N. dubia* Wm. Smith
Nitzschia sp.
Seeds
Chara requena n.sp.
Chenopodium sp.
Eupatorium sp.
Sponge spicules
Ephydatia aufioxa J. Frenguelli
Ephydatia aufidiscos J. Frenguelli

All the diatoms are found living in fresh or brackish water with the exception of three species. These three species, which appear to be very rare and much broken, are; *Melosira sulcata, Stephanopyxis corona,* and *Sceptroneis* sp. (probably *S. caduceus*). The first of these lives in marine and brackish water today and has been found in the Middle Miocene of North America along with *Stephanopyxis corona* and *Sceptroneis caduceus.* The last two species, however, are both extinct. The presence of these Miocene diatoms in the fresh-water marl bed probably means that they were reworked from some Miocene

deposit in the region of Lake Tacarigua. Although no Miocene deposits are known very close to Lake Tacarigua the minuteness of these diatoms makes it easily possible for them to be carried great distances before they are redeposited. The sponge spicules have been found in tripoli deposits of Quaternary age from Chile.

I was able to determine a few of the seeds found in this marl bed; one, a new species of *Chara* and one each of *Chenopodium* and *Eupatorium*. However the majority had to be left undetermined for want of comparative material.

Chara requena n.sp.

Figs. 6, 7.

The oogonium is very minute, being 79.8μ long and 52.5μ broad. It is elliptical in profile and circular in cross section. There are 12 convolutions which form a low spiral. The spiral cells are concave making a deep furrow between the extended keels of the cell margins. The width of the cell taken from keel to keel is 5.8μ in the center region of the oogonium. There is a round hole at the basal end while the cells unite in a low nondescript rosette at the apical end.

Six specimens of *Chara* oogonia were found in the lower fresh-water marl bed and only one in the overlying bed. They appear to be all of the same species; however, the lone specimen from the upper bed is somewhat larger than the rest. Most of the specimens have their apical or basal end broken so I have therefore taken the most perfect one as the type and described it above. I have given this *Chara* oogonium the specific name of *requena* in honor of Senõr Rafael Requena.

James Groves[3] states that *Chara perpusilla* is the smallest charophyte that has been found in the Tertiary deposits. The dimensions for the oogonium of this species he gives as 275–300μ long and 200–250μ broad. These dimensions greatly exceed those of the above described species.

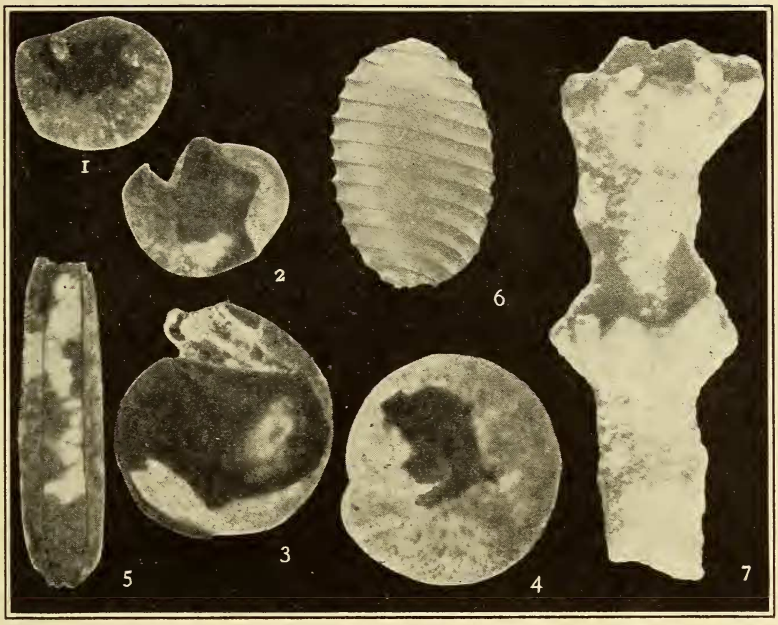
With these *Chara* oogonia were found numerous pieces of stems, all similar in appearance. One piece (Fig. 7) was preserved showing two nodes. On the upper node there are the remains of six branches while on the lower node there appear to be seven branches. It is safe, I think, to say that these pieces of stem belong to the same species as the oogonia do, as only one type of oogonium is present in these deposits.

CHENOPODIUM sp.

Figs. 1–4.

In the lower fresh-water marl bed I found four seeds which belong to the genus *Chenopodium*. All these seeds are very small and poorly preserved. In most of them the outer black coating—which is made up of a hard thick material, irregularly pitted—has been partly broken off thus showing the

[3] GROVES, J. *The Bembridge Flora. Cat. Cainozoic Plants* by E. M. REID and M. E. J. CHANDLER. Brit. Mus. Nat. Hist. 1: 173. 1926.



Figs. 1–4.—Seeds of *Chenopodium* sp. ×19. 5 Seed of *Eupatorium* sp. ×19. 6 Seed of *Chara requena* n.sp. ×42. 7 Stem of *Chara requena* n.sp. ×29.

gray fibrous underlying layer. One end of the coiled embryo can be seen clearly, for it has broken away from the general elliptical profile of the seed. The groove which runs down from the crest to the periphery of the seed can be partly discerned. This groove marks the position of the embryo on the inside.

Chenopodium is a very wide spread herb, which in certain regions reaches the size of a small shrub. It is found growing in South America today and this fossil species is probably represented by some present day species of *Chenopodium* living in the same region. With such poorly preserved seeds it is not possible to identify them with living species.

Eupatorium sp.

Fig. 5.

One poorly preserved seed of *Eupatorium* was found in the lower fresh-water marl bed. This seed is partly covered by a white calcareous material so that only a portion of the outside surface is exposed. The entire outside surface of the seed—which is divided into five long flat rectangular areas by longitudinal ridges—is covered by a minute semi-rectangular network of ridges. The seed is about four times as long as it is broad and both of its ends are broken open.

Eupatorium is a very wide spread genus of plants, found in both North and South America. I am certain that the same species now lives in the region of Lake Tacarigua, but I have been unable to procure any compara-

tive material which would permit one to give a specific name to this lone seed.

Apparently this lower marl bed was being deposited, or had just been deposited, when the lake dwellers came to the region; for in this bed have been found piles upon which the people constructed their houses. However, no artifacts of any kind were found. What climatic or earth changes took place to alter what was apparently a clear, freshwater lake into one full of mud, I do not know. But evidently this alteration took place about the time the lake dwellers came.

The upper bed, which is 2 to 3 feet thick, is the type of deposit that would be laid down in muddy water containing much vegetable matter. Some of the animals which appeared in the underlying marl still survived, but most of the fauna of the upper bed is different. The same Ostracods are present, but their number has decreased almost to the vanishing point. Also *Planorbis pronus*, which was so abundant in the lower bed is very scarce in this upper bed. Large gastropods predominate and it is a question whether they are indigenous or had been used as food and the shell remains thrown overboard. The same fish (*Geophagus brasiliensis*) inhabited the water. Small pieces of wood, which are carbonized, have their structure well enough preserved so that one is able to say that they belong to some dicotyledon similar to many Lauraceae. This, or similar tropical hard wood, probably formed the piles upon which the lake dwellers built their houses. It is within this bed that human remains have been found, proving that this deposition was contemporaneous with, or just antecedent to, the time of the lake dwellers.

The following is a list of the different forms (omitting the marine fauna) found in the upper bed:

Fishes
- *Geophagus brasiliensis* Quoy & Gaimard

Mollusca
- *Planorbis lugubris* Wagner.
- *Planorbis pronus* v. Mart.
- *Labyrinthus plicatus* Born.
- *Auris dictorta* Brug.
- *Pomacea glauca* Linné.
- *Pomacea glauca dubia* Guilding.
- *Pomacea cinqulata* Philippi.
- *Pomacea aurostoma* Lea.
- *Strophocheilus oblongus* Müller.
- *Plekochielus venezuelensis* Nyst.
- *Unio* sp.
- *Cerion uva* Linné.

Eucrustacea
Cryptocandona valencia n.sp. Blake.
Dolerocypris berryi n.sp. Blake.
Spinocypris macracanthos n.g. et n.sp. Blake.
Cypridopsis fuhrmanni? Mehes.
Potamocypris sp.
Darwinula sp.
Cytheridella tacarigua n.sp. Blake.
Seeds
Chara requena n.sp.

The most difficult question in connection with these deposits is their age. The marine forms which were used both as food and ornaments, inhabit the present day Venezuelan shore. The terrestrial forms also are found in the region, with the exception of *Cerion uva.* Traces of color patterns can be observed in individuals of both classes of shells, but there is also undoubted evidence that most of the shells have been buried for a great number of years.

Requena[4] lists the following fossils as having been found with the human remains:

Marine
Triton variegatus
Strombus pugilis
Cypraea exantema
Lucina tigerina
Lucina jamaicensis
Oliva jaspidea
Fissurella sp.
Nerita sp.
Terrestrial
Pachychilus laevissimus
Planorbis olivaceus
Ampullaria glauca
Ampullaria urceus
Bulimus pardalis
Bulimus distortus
Strophia uva

The above list shows some evident differences from mine. These differences can be due either to the fact that there may have been some mistake in the identification in the older list that Requena has published or to the fact that I did not receive a complete representation of the fauna which is to be found there. I am of the opinion that probably both explanations are true.

The only outstanding shell which could give any clue to the age of the deposits is a small worn shell of the land mollusc, *Cerion uva.* This land snail is an inhabitant of the Island of Curaçao and has never

[4] REQUENA, R.—*Op. cit.* p. 242.

been reported from the mainland before. Curaçao is a small island off the coast of Venezuela, 130 miles in a direct line northwest of Lake Tacarigua. Did it live in the region of Lake Tacarigua in these prehistoric times and since become extinct, except on this one island, or was it imported by humans for some object of ornamentation such as for necklaces or the like, or did it come on drifting objects brought by the sea currents?

Of the three alternatives which present themselves as an explanation of why *Cerion uva* is present in these deposits, one can be ruled out with considerable assurance. That is, that ocean currents acted as agents for transportation. This is impossible for the Southern Equatorial Current which travels westward across the Atlantic divides into two parts at Cape San Roque. One part which travels northward is the Guiana Current, the other which flows southward, the Brazil Current.[5] The current which skirts the northern shore of South America is called the Main Equatorial Current, but as it nears the West Indies it is known (by some authors) as the Guiana Current. This current enters the Caribbean Sea between the Lesser Antilles and the mainland of South America and skirts the northern shores of Venezuela. Thus there could be no drifting of material in an eastward direction as would be necessary if *Cerion uva* originated on the Island of Curaçao. This leaves the two other questions to be discussed—man as the sole agent of transportation; or—the specimen is indigenous. Both explanations are quite plausible. For, as we have already seen, these prehistoric people traveled and brought in marine organisms for food. They may very well have traveled the entire distance from the Island of Curaçao to Lake Tacarigua. The last question is—is *Cerion uva* indigenous? That is possible, but I have very little definite evidence—one badly worn specimen—to base such an assumption on. However, included in Senõr Requena's list[6] of the fossils found in the region is *Strophia uva* which is just another name for *Cerion uva.* This shows that there was more than one specimen of the shell present in these deposits. This fact lends a somewhat greater probability to the hypothesis that *Cerion uva* is indigenous to the region of Lake Tacarigua. However, the evidence is inadequate to decide between the two possibilities.

The fossils now at hand throw little light on the age of these beds. Most of the fossils found live in the same region today with the ex-

[5] Guppy, H. B. *Plants, seeds and currents in the West Indies and Azores*, p. 60. 1917.

[6] Requena, R. *Op. cit.*, p. 242.

ception already noted. However, I think one can be fairly safe in saying that these deposits were laid down during the late Pleistocene epoch. It is always necessary to bear in mind while discussing the Pleistocene of the tropics that no pronounced change between it and the Recent took place. Probably the age of these deposits could be more surely determined if one had a complete collection of all the fossils which are to be found in the two beds.

BOTANY.—Pedilospora dactylopaga *n.sp., a fungus capturing and consuming testaceous rhizopods.*[1] CHARLES DRECHSLER, Bureau of Plant Industry.

In permitting the development of a microscopic fauna, however restricted in variety of types, agar plate cultures made for the purpose of isolating fungi from diseased rootlets and other decaying plant materials, often afford a tolerably abundant growth of adventitious fungi destructive to different species of the more minute terrestrial invertebrates. As the destruction takes place in a transparent substratum the parasitic and predacious relationships are conveniently exposed to view. Fungi that on a natural substratum show only their aerial conidial apparatus, and would therefore ordinarily be taken, indeed, in some cases have long been taken, for saprophytes, are revealed in their true carnivorous character. Very probably because nematodes and amoebae of various species multiply most freely in agar plate cultures, instances of predacious and of parasitic activity involving these animals as prey or as hosts can be more frequently seen than instances of destruction of other microscopic animals. The capture of two species of testaceous rhizopods identified as *Difflugia globulosa* Duj. and *Trinema enchelys* Ehrenb. that I had opportunity to observe recently, provides therefore an element of novelty which is accentuated by the curious morphology of the fungus concerned.

As on agar plate cultures at least, the two rhizopods mentioned, like most other shelled protozoans, are decidedly sluggish in movement, their capture entails no violent struggle. That *Trinema enchelys* does not accept its fate altogether passively is indicated in the overturned posture of many a specimen, the mouth of which is directed upward rather than downward as normally. Except for such abnormal posture, captured animals are to be distinguished for the most part only by what on cursory examination would seem to be ordinary contact with a short branch on one of the superficial fila-

[1] Received June 18, 1934.